

## Executive Summary

Breast cancer is the most common non-skin cancer in women and the second most common cause of cancer-related death in U.S. women. An estimated 215,000 new breast cancer diagnoses and 40,000 breast cancer deaths are expected in 2004. White women have the highest breast cancer incidence rates, followed by African-American women. While overall mortality due to breast cancer has been declining during the past decade, the rate for African-American women is greater than that for women of other racial/ethnic groups. These recent trends of stabilizing incidence and decreasing mortality rates are encouraging, but breast cancer remains a major health burden for American women and requires continued action.

In 1997, the National Cancer Institute (NCI) convened the Breast Cancer Progress Review Group (PRG), a multidisciplinary working group of scientists, clinicians, and advocates, to help NCI define a national research agenda for breast cancer. The Breast Cancer PRG issued a 1998 report entitled *Charting the Course: Priorities for Breast Cancer Research*, which included research questions that should be addressed to advance prevention, detection, diagnosis, and treatment of breast cancer. An internal NCI Breast Cancer Working Group was convened in 2004 to assess the research progress made since the release of this report.

The NCI Breast Cancer Progress Report documents trends in the NCI breast cancer research portfolio from 1998 to 2003. Multiple measures of progress are presented at varying levels of specificity, ranging from overall trends in NCI funding, projects, and resulting peer-reviewed publications to more specific trends in the number of projects relevant to particular research priorities identified by the PRG.

Between 1998 and 2003, NCI substantially expanded investments in breast cancer research, as evidenced by:

- Increasing breast cancer funding by nearly 60%, from \$348.6 million in 1998 to \$548.7 million in 2003.
- Increasing the number of relevant projects by 60%.
- Expanding ongoing and initiating new programs to sustain and advance both basic and clinical breast cancer research.
- Expanding the Breast Specialized Programs of Research Excellence (SPOREs) network from 4 to 10 sites.
- Expanding collaborative efforts, public-private partnerships, and shared resources to improve the capacity to conduct breast cancer clinical trials.

During these years, new and innovative types of treatment, preventive measures, and diagnostic techniques have been developed and approved or are being studied in clinical trials, including:

- Tamoxifen (Nolvadex®) for the prevention of breast cancer in high-risk women.
- Aromatase inhibitors (anastrozole, exemestane) for treatment of estrogen receptor-positive breast cancer.
- Monoclonal antibodies (Herceptin®) for treatment of tumors that express Her2/ErbB2.
- Sentinel node biopsy for less-invasive surgical diagnosis and prognosis.
- Lumpectomy with radiation as an equivalent alternative to mastectomy for certain stages of disease.
- Preoperative (neoadjuvant) therapy to reduce the size of large tumors, thereby allowing more women to undergo breast-conserving therapy.

Work is under way to translate the discoveries generated by this expanded investment into new breast cancer prevention, detection, diagnosis, and treatment interventions that will save lives. The following two pages summarize NCI's investment by research category.

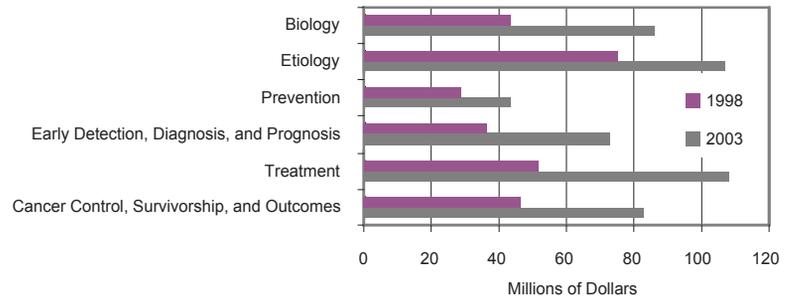
NCI's ability to capitalize on advances in breast cancer research and care will require continued basic, translational, and clinical research support. This progress report, which documents NCI's responsiveness to the recommendations of the Breast Cancer PRG, will help guide the Institute's efforts to make course corrections and develop new recommendations regarding breast cancer research.

## NCI's Breast Cancer Research Investment

NCI's breast cancer research investment increased from \$348.6 million in 1998 to \$548.7 million in 2003.

### Biology

- Funding increased from \$43.2 million to \$86 million.
- The number of projects increased from 257 to 504.
- New initiatives included the Bioengineering Nanotechnology Initiative, Complex Formation in Hormonal Regulation of Gene Expression, the Mammalian Gene Collection, and Molecular and Cellular Biology of Metastatic Tumor Cells.



**Growth of NCI's Investment in Extramural Research by Scientific Category**

### Etiology

- Funding increased from \$75.3 million to \$107.2 million.
- The number of projects increased from 263 to 424.
- New initiatives included Breast Cancer and the Environment Research Centers, Cohort Studies in Cancer Epidemiology, Interdisciplinary Studies in the Genetic Epidemiology of Cancer, and the NCI Cohort Consortium.

### Prevention

- Funding increased from \$28.9 million to \$43.7 million.
- The number of projects increased from 190 to 295.
- New initiatives included Chemoprevention of Estrogen Receptor-Negative Breast Cancer Preclinical Studies, Phase I and II Cancer Prevention Clinical Trials Consortia, the Study of Tamoxifen and Raloxifene (STAR) Trial, and the Rapid Access to Preventive Intervention Development Program.

### Early Detection, Diagnosis, and Prognosis

- Funding increased from \$36.4 million to \$73.2 million.
- The number of projects increased from 197 to 288.
- New initiatives included Development of Digital Mammography Displays and Workstations, Development of Novel Technologies for *In Vivo* Imaging, the Diagnostic Imaging Network–American College of Radiology Imaging Network, the Early Detection Research Network, and Innovative Technologies for the Molecular Analysis of Cancer.

### Treatment

- Funding increased from \$52 million to \$108.2 million.
- The number of projects increased from 302 to 493.
- New initiatives included Cancer Therapy-Related Use of Genetically Engineered Mice, Development and Application of Imaging in Therapeutic Studies, Quick Trials for Novel Cancer Therapies, and the Translational Research Initiative.

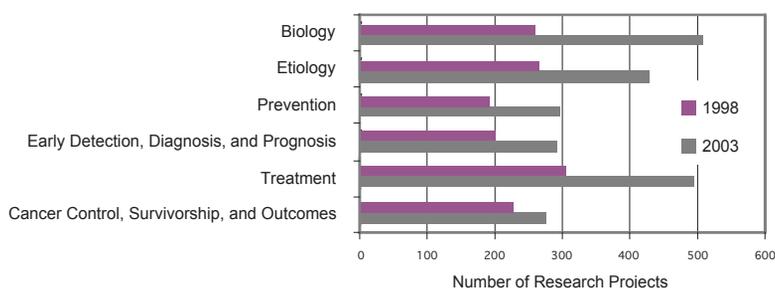
**Cancer Control, Survivorship, and Outcomes**

- Funding increased from \$46.6 million to \$82.8 million.
- The number of projects increased from 224 to 274.
- New initiatives included Cancer Control PLANET, Centers of Excellence in Cancer Communications Research, Exploratory Grants for Behavioral Research in Cancer Control, Health Communications in Cancer Control, and Minority and Underserved Cancer Survivors.

## Examples of Progress Resulting from NCI's Breast Cancer Research Investment

**Biology**

- Recent advances include new mouse models that mimic breast cancer in humans, the discovery of factors that contribute to mammary tumorigenesis, and elucidation of the functional characteristics of mammary epithelial stem cells.
- Future investment is needed in the areas of normal mammary development and the integration of biological information across various model systems.



**Growth of NCI's Breast Cancer Research Program  
by Scientific Category**

**Etiology**

- Recent advances include the identification of new breast cancer susceptibility genes, determining environmental influences on breast cancer development, and identifying behavioral risk factors.
- Future investment is needed in validating the association and causation of putative susceptibility genes with breast cancer risk, identifying linkages between genes and the environment, and understanding the role of endogenous hormones.

**Prevention**

- Recent advances include the development of new models of precancerous biology, determining the association between the consumption of certain dietary components and reduced breast cancer risk, and identifying effective strategies for reducing breast cancer incidence.
- Future investment is needed in developing an intervention strategy that reduces the incidence of both ER-positive and ER-negative breast cancer and determining why some of the women who use preventive interventions like tamoxifen develop breast cancer in spite of the intervention.

**Early Detection, Diagnosis, and Prognosis**

- Recent advances include the development of novel digital imaging devices, newly identified biologic markers, and the use of computers to improve the diagnostic accuracy of breast imaging.
- Future investment is needed in improving the sensitivity and specificity of screening film mammography and the reproducibility of computer-aided devices and determining the uses of newly identified biomarkers.

**Treatment**

- Recent advances include improved treatment of *in situ* disease, refinements in all aspects of the traditional treatment paradigm, and treatments that prolong survival in women with nonoperable breast cancer while maintaining quality of life.
- Future investment is needed in the development of noninvasive approaches for primary breast cancer ablation and integrating noninvasive imaging techniques to better appreciate the activity and mechanism of action of targeted therapies in Phase I and II studies.

**Cancer Control, Survivorship, and Outcomes**

- Recent advances include techniques to increase the number of women screened for breast cancer, examining the impact of breast density and breast positioning on mammographic accuracy, and understanding the impact of social support on survivors' well-being.
- Future investment is needed in communications strategies to educate more women about the importance of mammography, increasing the rate at which underserved populations are screened for breast cancer, and ways to increase the accuracy with which mammograms are interpreted.